Feedback manipulation and learning in games

Addendum: Valorization

This final chapter discusses the valorization opportunities of this thesis, in accordance with article 23.5 of the "Regulation governing the attainment of doctoral degrees" of Maastricht University. Knowledge valorization refers to the "process of creating value from knowledge, by making knowledge suitable and/or available for social (and/or economic) use and by making knowledge suitable for translation into competitive products, services, processes and new commercial activities" (adapted definition based on the National Valorization Committee). This section will discuss the broader implications and potential practical uses of the findings presented in this thesis. One should of course take these suggestions with caution and keep in mind that most findings come from experiments with small student samples in a laboratory setting. It is therefore not clear whether the interventions that work in experiment could be generalized. One should also carefully consider the potential negative side effects of the proposed suggestions.

The thesis uses theory and experiments to understand why an efficiency loss occurs and how it can be minimized in two types of situations. This chapter will briefly review the main findings and will show how these findings could be used by policy makers, managers or consumers.

Chapter 2 addresses the efficiency loss that occurs because of the choice of dominated strategies in a contest game. In contest experiments two parties compete for a fixed prize my making costly investments and the probability to receive the prize is proportional to the investments. There is robust experimental evidence that in such contests players often invest more than they should according to theoretical predictions. In some situations such overinvestments may be desirable while in others they may not be. If firms are competing for the the market share by investing in R&D, overinvestments may be beneficial to the society. Likewise, the chances that a worker will receive a bonus may be increasing in their effort and employers may attempt to design a system that maximizes the effort exerted by all workers. In other circumstances investments

may be wasteful, such as when politicians are competing in elections and when firms are investing in advertising or lobbying. Knowledge about the factors that affect investments could enable policy makers and managers to influence investments in a desirable way. For example, chapter 2 shows that when the actions of the other participant are know, subjects with higher cognitive abilities invest less than those with lower abilities.

However, chapter 2 shows that overinvestments are in large part a reflection of behavioral variability and noise that are present in contests. In fact, a Tullock contest is a good example of a game in which subjects make a clear mistake, which could not be explained by preferences or beliefs. More than half of the time players choose dominated strategies – these are strategies that generate lower earnings that some other strategy, regardless of what other players will choose – and there is high behavioral variability. Tools that could reduce the behavioral variability and increase the frequency of optimal strategies might also be used to improve decisions in other settings. We do find that in some treatments subjects with higher cognitive abilities perform better, but improving cognitive abilities is not an easy task and the computational complexity required to identify dominated strategies is so high that even those with the highest cognitive abilities are unable to perform it. A much easier way to avoid mistakes is by learning: subjects who track choices and payoffs, either their own or those made by others, could identify payoffs that lead to poor payoffs and avoid them. We find that when the complexity of the game is reduced, most people learn to play optimal strategies. For this to happen, three elements are of particular importance: subjects must be able to anticipate what others will choose, receive accurate feedback about their choices and they must be able to learn over time. If any of these elements is missing, the frequency of mistakes (i.e. choice of dominated strategies) and noise (i.e. behavioral variation) go up significantly.

These findings could be used to improve the quality of feedback that hinders learning. In fact, there already are programmes that aim to do that. Energy bills that compare current expenses to those in the past, as well to the performance of other households, have been shown to reduce expenditures (Allcott, 2011). Failure to understand probabilistic statements in medical decision making have lead to information being presented in formats that are easier to understand (Bornstein and Emler, 2001). Chapter 2 also shows that when conditions are suitable for learning, subjects are more likely to sample different actions when doing so is costless. Experimentation could therefore be another element that is necessary for learning. Decision makers who never

change their habits might never try better alternatives, and would therefore never learn about their superiority.

The second problem addressed in this thesis is the emergence of inefficient conventions, which may be implemented in situations with multiple alternative stable states. Multiplicity of stable states can occur because of strategic complementarity: for example, a person may cycle to work, recycle, pay taxes or avoid littering only if he expects that others will behave the same way. Incentives to coordinate on a common action drives choices towards one of the two stable states, and it is possible that an inefficient state will be implemented. Once this happens, an inefficient convention is hard to replace even if everyone involved would prefer a collective switch to the efficient convention. The understanding that the current situation is inefficient is not enough – participants must also expect sufficiently many others to deviate from an inefficient convention. For example, cycling might be dangerous if car drivers are not used to seeing cyclists on the road, making it hard to promote cycling even if everyone knew about its benefits and would willingly cycle to work as long as others do the same. To promote desirable actions a policy maker should therefore not only convince the public about its benefits, but also attempt to structure the environment in a way that increases the likelihood of efficiency-enhancing transitions. This thesis aims to increase our understanding about the ways how inefficient convention can be replaced, using both theory (chapter 3) and experiments (chapter 4).

Chapter 3 provides a framework that can be used to analyze situations in which an inefficient convention has been established. The model makes predictions about the types of symmetric equilibria that exist in a given game, and shows how these existence conditions can be calculated from the game parameters. It also shows how these existence conditions are affected by changes in parameter values. While some of the findings are intuitive – for example, a transition to the efficient state is more likely and faster if players have a longer planning horizon, other results are more surprising. If the number of sophisticated players is too large, chances of a transition may even decrease because each sophisticated player may find free-riding more attractive.

Chapter 4 studies inefficient conventions using an experiment. An important finding of this chapter is that farsighted players tend to deviate from inefficient conventions more often. This finding reinforces the results from chapter 3 and shows that a group can move from the inefficient to the efficient state if it has some sophisticated players. This could be potentially useful for managers, as coordination failure is not uncommon when output depends on the effort put in by the slowest member in the group. If a team gets stuck it in an

inefficient state, the presence of several farsighted players may help turn it around. Farsightedness could therefore be one of the criteria used to assign players into teams and allocate their roles.

One question that guided the design of the experiment presented in chapter 4 was the role of information technology in facilitating protest movements. Finding ways to help citizens in oppressed countries rise up against the regime could affect millions of people. If findings from chapter 4 could be taken at face value, uprisings could be facilitated by allowing citizens to make their actions observable. Information technology is certainly one possibility, as it enables the use of social media to communicate with each other at a low cost. But other tools that increase the observability could be effective too. Any accurate information about the current events might improve the participation levels, and such information is often lacking in the absence of free media. Protest movements might therefore be supported by providing better information or by improving the existing media channels. Interventions that seek to improve the quality and quantity of information that is available to the participants are rather easy to implement, which is one of the reasons why they were chosen to be studied in this thesis. It might not be possible to change the payoffs of the citizens, the order of moves or the group size, but interventions that provide better information or better tools for information sharing could be implemented easily and at a low cost.